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TRIBAND WEED CONTROL

A NEW CONCEPT FOR WEED CONTROL IN COTTON

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Triband Weed Control - A New Concept for Weed Control in Cotton [1/]

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Recent developments in weed control technology and engineering have made it possible to develop new concepts of weed control in row crops. One such opportunity involves the integration of subsurface, conventional preemergence, and postemergence treatments into a system for control of weeds in cotton. Although each of these treatments can be developed independently for use in a combination system, the effort can be expedited by use of a concept described as "triband."

The triband concept of weed control recognizes and utilizes three zones which exist in row crops. The zone in which the seed are placed (drill row) is the central zone. On each side of the drill row are the other two zones--the row shoulders. The basis for the triband concept is that the width of the central band can be reduced and the control of weeds therein simplified through complete control of weeds in the adjoining shoulder-area bands. Width of these bands need not be fixed, but can be varied according to the particular weed problem, crop, and herbicide to be used.

A narrow band of weeds enclosed by two weed-free bands of smooth soil presents a much simpler control problem than a wide band of weeds enclosed by cultivation-roughened shoulder areas. For example, laterally directed sprays of herbicidal naphthas in cotton may fail when heavy growth of grass across a 10- to 12-inch band prevents penetration of the naphthas into the center of the band. Roughness of the row shoulders caused by cultivation and weeds in the shoulder area where the postemergence applicators run also contribute to poor coverage in the drill area.

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Herbicidal treatments applied in the drill row must be highly selective; shoulder treatments, being further removed from the crop, may be less selective. Combination of moderately effective, highly selective drill-row treatments with highly effective but perhaps relatively nonselective treatments of the row shoulders may result in several advantages. For example the effectiveness of postemergence naphtha and flame cultivation for selective control of annual weeds and nutsedge in the drill row of cotton is greatly influenced by the row profile, the width of the drill-row band, the control of weeds on the row shoulder, and the density of the weed infestation in the drill-row band.

The primary objective of the research reported here was to increase the efficiency of drill-row applications through complementary treatments to the shoulder area. The research completed to date is not conclusive, but does appear to establish the feasibility of the triband approach.

MATERIALS AND METHODS

A series of field experiments on weed control in cotton was started in 1960. The establishment of a weed-free band on each shoulder of the row without damage to the cotton was attempted in all the experiments. These bands were about 6 inches wide and centered about 6 inches from the center of the drill row. Treatments used to establish these bands on the shoulders included 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) applied preemergence at 1.5 lb./acre (1.5 times the conventional rate), high rates of herbicidal naphtha, flame cultivation, and subsurface ethyl N,N-di-n-propylthiolcarbamate (EPTC) applied 1½ inches deep at 1 to 3 lb./acre as the cotton was planted.

Control of weeds in the drill-row band was attempted with diuron applied preemergence at 1 lb./acre, postemergence herbicidal naphtha at 20 to 28 gal./acre, postemergence diuron (0.2 lb./acre) plus surfactant (1 lb./acre), and flame.

Cotton was planted by hill-dropping in plots consisting of 2 to 8 rows 30 to 80 feet long. A randomized complete block design with 3 to 6 replications was used. All experiments were conducted in Bosket fine sandy loam. Weed populations consisted of moderate to heavy infestations of annuals with scattered spots of nutsedge (Cyperus rotundus L.)

Effectiveness of the treatments was evaluated by weed control ratings and hoe-labor requirements. Cotton tolerance was evaluated by crop reaction ratings and yield of seed cotton. Ratings of 0-30 = slight injury; 40-60 = moderate injury; 70-90 = severe injury; 100 = all plants killed.

Rates for all herbicides are expressed on a broadcast basis although most of the treatments were applied in bands.

RESULTS AND DISCUSSION

Subsurface preplanting applications of EPTC have effectively controlled nutsedge and annual grasses in cotton at rates of 1 to 10 lb./acre (3) [3/]. Cotton tolerance of solid bands of EPTC applied below or level with the cotton seed, however, has not been satisfactory.

Diuron or isopropyl N-(3-chlorophenyl)carbamate (CIPC) applied preemergence usually give excellent control of many small-seeded annual weeds if rain falls soon after application. Both chemicals perform poorly in the absence of rain or irrigation, and neither will control nutsedge.

Postemergence naphtha, applied in cotton 1 to 5 weeks old to properly prepared and maintained seedbeds, will control light to moderate infestations of nutsedge and many annual seedling weeds without injury to cotton. However, in heavy infestations, where the weeds are large and where cultivation has roughened the shoulders, coverage of the weeds is difficult to accomplish, and the results may not be satisfactory. Control of weeds in a zone extending from 3 to 6 inches from the drill-row center is particularly difficult to obtain.

Diuron plus surfactant applied postemergence is subject to many of the same restrictions as herbicidal naphtha, but is more economical, is safer in cotton older than 4 weeks, not as safe in younger cotton, and does not control nutsedge. Postemergence flame in the drill row is very similar in all respects to herbicidal naphtha except that it is much safer in cotton taller than 10 inches and not safe in smaller cotton.

Some of the value of combining treatments in many crops has been recognized. For example, herbicide mixtures may act additively on weeds or one component of a mixture may control some species which are tolerant to another component (1). Also two or more applications of the same or different herbicides applied in series generally provide better control of the initial infestation than one application, and will often provide control of secondary infestations (2). Little research, however, has been conducted to evaluate the effects of one application on the effectiveness of a following application. Our attempts to do this resulted in the formation of the triband concept. Division of the crop row into three bands (figure 1) has been helpful in communication between workers, and to illustrate herbicide placement. Width of various bands is described by use of the following three-part code:

10 - 4 - 10

[3/] Figures in parentheses refer to Literature Cited at end of report.

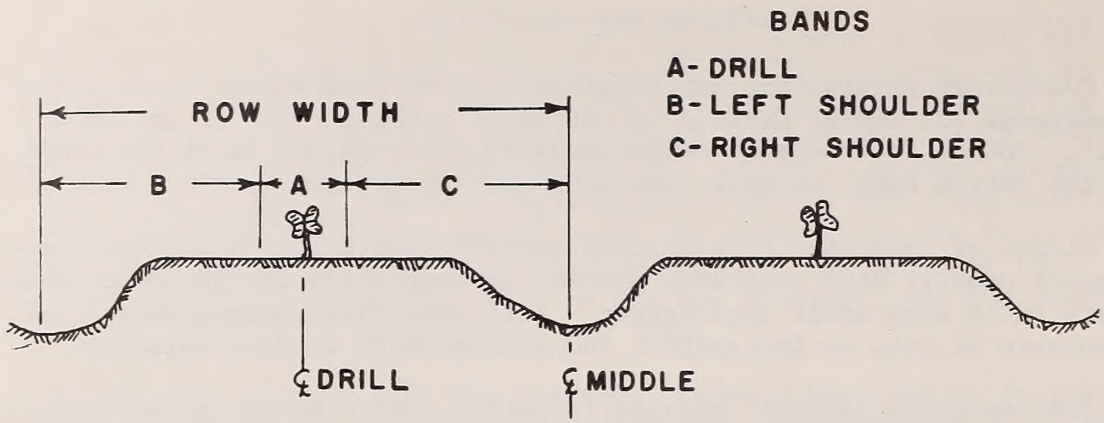

Figure 1.--Division of the crop row into 3 lateral bands. All three bands can vary in width; bands B and C can stop short of the row middle.

The outside numbers give the width of treated shoulder bands (figure 1, B and C) in inches. The central number is the width of the untreated drill-row band in inches. Two examples should facilitate the explanation of this terminology:

Example 1. EPTC was applied subsurface at 1 lb./acre at planting time at a depth of 1½ inches as a 6-8-6 triband placement (figure 2, A).

Example 2. Diuron was applied to the soil surface at 1 lb./acre pre-emergence as a 6-0-6 triband placement (figure 2, B).

In the first example a split band treatment was used with the 8-inch <u>untreated</u> band centered over the seed. In the second example a conventional

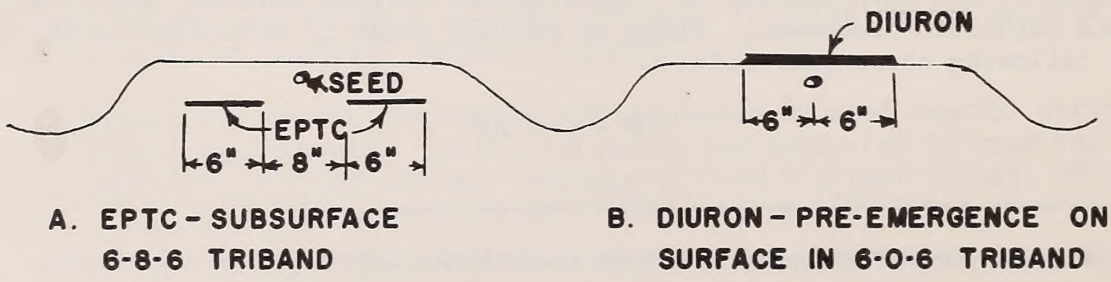

Figure 2.--Illustration of triband terminology.

12-inch band centered over the seed was treated, which in effect means that the central untreated band was zero inches in width. This terminology, while admittedly somewhat complex, is essential to accurate descriptions of the technique. It can be used to describe treatments applied subsurface, surface preemergence, or postemergence, as solid bands, split-bands, or broadcast. Flame application, herbicides, and cultivation can be described as triband treatments.

Trials of shoulder and middle treatments began as early as 1948, but systematic research on the triband technique at the Delta Branch Experiment Station began in 1960. Early results were somewhat less than satisfactory because many of the triband applications (such as subsurface EPTC, shoulder flaming, and use of naphtha at high rates) could not be applied with the required precision. Precision control of herbicide and flame placement was attained in 1962 as the result of development of a subsurface herbicide applicator in 1960 (4, 6), a highly versatile postemergence applicator in 1961 (7), a combination precision planter-subsurface herbicide applicator in 1962 (8) and an efficient flaming device for applying controlled heat to row middles in 1962 (5). The combined planter-subsurface sprayer complex was essential in the 1962 experiments; its design and construction are presented in a separate report (8).

Research has been directed toward developing techniques for application of herbicides to the shoulder of the row with acceptable crop tolerance. Nutsedge was present in heavy infestations occurring as scattered spots in the 1962 experimental areas. Performance of the more effective triband treatments in these spots was very satisfactory.

Diuron applied preemergence in 1960, 1961, and 1962 at 1.5 lb./acre as a 6-6-6 triband treatment combined with 6-0-6 triband postemergence treatments gave control equal to that in comparable plots receiving the diuron preemergence as a 6-0-6 triband treatment at 1 lb./acre (table 1). Cotton tolerance to the treatments did not appear to be affected by the method of application. In this experiment the shoulder-area preemergence treatments did not appear more effective than drill-row preemergence in enhancement of the effectiveness of the postemergence treatments. Lack of success with the 6-6-6 triband diuron treatment was attributed to the mediocrity of control obtained in the shoulder-area bands. The increased rate of application, while not injuring the cotton, failed to provide the expected degree of annual weed control.

A much more promising practice has been the use of EPTC as a subsurface application for control of nutsedge and annual weeds. Control of annual weeds with EPTC applied preplanting at 1 to 4 lb./acre as a subsurface 10-0-10 triband treatment has been highly satisfactory in experiments conducted in 1960 and 1961 (table 2). Cotton tolerance, however, was not satisfactory.

Table 1.--Hoe-labor requirements and yield of cotton in plots treated with specified triband treatments (average 6 replications--3 years).

Surface preemergence treatment	Postemergence treatments[a]	Hoe labor hr./acre	Yield of seed cotton--lb./acre
Diuron 1.5 lb/A in a 6-6-6 triband	6-0-6 triband	15	2,440
Diuron 1.5 lb/A in a 6-6-6 triband	None	42	2,480
Diuron 1.0 lb/A in a 6-0-6 triband	6-0-6 triband	16	2,410
Diuron 1.0 lb/A in a 6-0-6 triband	None	30	2,470
None	6-0-6 triband	32	2,530
None	None	50	2,540

[a]/All plots hoed and cultivated; 6-0-6 triband treatments were with either substituted ureas in a phytobland oil or herbicidal naphthas.

Table 2.--Hoe-labor requirements and cotton reaction ratings in plots treated with specified triband treatments with subsurface EPTC (average 3 to 6 replications).

EPTC treatments applied subsurface [a]	Hoe labor requirements hr./acre	Cotton reaction ratings [b]
1960:		
None	52	0
1 lb/A as 10-0-10 triband	9	40
1961:		
None	56	0
1 lb/A as 10-0-10 triband	20	61
1962:		
None	(--[c])	0
1 lb/A as 6-8-6 triband	(--[c])	5

[a]/All plots cultivated and hoed; no postemergence herbicides were used.
[b]/0 to 30 = slight injury; 40 to 60 = moderate; and 70 to 90 = severe.
[c]/Hoe-labor requirements not obtained; control in the drill row rated at 0 in checks and 62 percent in treated plots.

The treatment, therefore in 1962, was changed to a 6-8-6 triband treatment applied subsurface at planting time. Cotton tolerance (table 2) appeared satisfactory although general weed control was not as good as in 1960 and 1961 because the 8-inch drill-row band was untreated. General appearance of the 1962 treatment is indicated in figure 3.

The most promising practice to date, however, is a combination of diuron applied on the surface (6-0-6 triband) at planting, subsurface EPTC (6-8-6 triband) at planting, postemergence naphtha (5-0-5 and 5-5-5 triband), flame (5-0-5 and 12-16-12 triband), and restricted cultivation. In this combination early disturbance of the shoulder area by cultivation is avoided by substitution of the 12-16-12 triband flame and 12-16-12 cultivation for the conventional 15-10-15 cultivation. Yield of cotton in 1962 was not reduced by the subsurface use of EPTC in this combination (table 3). The first two practices listed in table 3 include only currently recommended treatments such as preemergence diuron, postemergence naphtha, and flame. The latter two practices are similar except for the addition of EPTC applied subsurface at planting. The experiments conducted in 1962 were the first in which subsurface EPTC was used without some reduction in yield. An encouraging fact about these data is that the rate of EPTC used was 3 times more than that which, in other experiments, was shown to be adequate for control of nutsedge and annual weeds.

Figure 3.--Nutsedge and annual weed control in cotton with 1 lb./acre of EPTC applied subsurface at planting in a 6-8-6 triband (1962).

Table 3.-- Yield of cotton from plots treated and not treated with subsurface EPTC at planting (averages of 6 replications -- 1962).

Treatments applied at planting [a]	Yield of seed cotton--lb./acre	
	Experiment 1	Experiment 2
Diuron on surface at 1 lb./acre in a 6-0-6 triband	2,230	2,270
None	--	2,160
Diuron on surface at 1 lb./acre in a 6-0-6 triband plus EPTC subsurface at 3 lb./acre in a 6-8-6 triband	2,260	--
EPTC subsurface at 3 lb./acre in a 6-8-6 triband	--	2,350

[a] All plots received highly selective postemergence treatments as needed for good control of weeds. These treatments included hoeing, cultivation, naphtha, diuron plus surfactant, flame, spot treatments, or combinations of several of these.

Unfortunately the weed infestations in the experimental areas were not severe in 1962, and the regular recommended practices gave almost perfect control of weeds (3 hr./acre of hoeing required in experiment 1, and 10 hr./acre in each of the two commonly recommended practices in experiment 2). No hoeing was required where EPTC was used, but 3 and 7 hr./acre of hand labor was expended in spot-spraying in experiments 1 and 2, respectively.

The tremendous weed control potential of the triband method is indicated, however, in figures 4 and 5. These pictures, showing one plot in which cultivation was delayed for demonstrational purposes, were made before any cultivation or spot-treatment, and immediately before initiation of flaming. Figure 4 shows the high degree of control in the shoulder areas. In figure 5 the drill area can be seen to contain small, isolated nutsedge plants and an ocasional annual grass which have survived previous treatments. Few of these survived subsequent flame and layby treatments.

The studies conducted to date are insufficient to characterize the effectiveness and safety of the proposed triband treatments. The results, however, indicate that the triband concept has merit, and that several of the specific treatments involved are feasible for a more complete evaluation of the concept.

Figure 4.--Control of weeds on the row shoulders with subsurface EPTC applied at planting and with postemergence naphtha; no hoeing or cultivation had been used. (Photo made 6 weeks after planting.)

Figure 5.--Control of weeds in the drill-row with preemergence diuron and postemergence naphtha, and on the row shoulders with subsurface EPTC applied at planting and with postemergence naphtha; no hoeing or cultivation had been used. (Photo made 6 weeks after planting.)

SUMMARY

All currently recommended combinations of treatments for weed control in cotton are applied in series and designed primarily to extend in time the control from one treatment by use of another, or to control some weeds that are not susceptible to treatments controlling other fractions of the weed population. Such an approach is logical and sound. On the other hand, benefits may also be obtained from treatments designed primarily to enhance the effectiveness of other treatments through prevention or removal of interfering factors. An approach, called the triband concept, which contains features of both philosophies was proposed and evaluated for consideration in future research.

The proposed triband concept involves consideration of the cotton row as three bands--the central drill-row band, and the two shoulders of the row. Good control of weeds in the shoulder-area bands should enhance control in the critical drill-row area. Postemergence control of weeds in a narrow drill-row band should be much simpler than control of weeds in a broad band. In addition, the control of weeds on the shoulder areas with means other than cultivation should facilitate maintenance of a uniform area for operation of postemergence application equipment. Since the shoulder areas are further from the cotton than is the drill-row area, highly active herbicides of low or moderate selectivity can be used on the shoulder areas to provide complete control of weeds in those two bands. Control in the central band can be attained with herbicides selected primarily for high selectivity on cotton and secondarily for activity on weeds.

Experiments conducted from 1960 to 1962 indicated that the triband concept has many advantages. Diuron applied preemergence on the surface combined with shoulder area treatments with subsurface EPTC at planting, followed by conventional postemergence naphtha and flame treatment of the drill and high-rate naphtha and flame on the shoulders, was the specific combination of treatments giving the most effective control of the entire weed spectrum and maximum cotton tolerance.

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